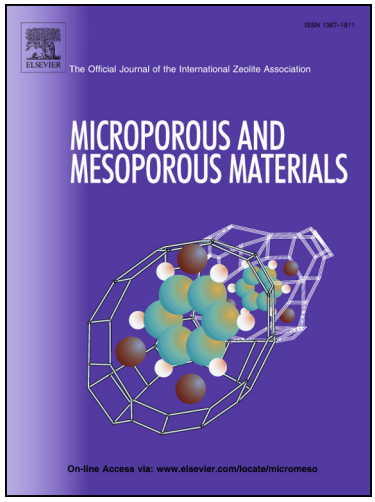

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Molecular Ordering of the Discotic Liquid Crystal HAT6 Confined in Mesoporous Solids

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Abstract

An optical polarimetry study of the orientational order of a discotic liquid crystal (DLC), 2,3,6,7,10,11-hexakis(hexyloxy)triphenylene (HAT6), confined into parallel-aligned cylindrical nanochannels of mesoporous alumina, silica, and silicon membranes as a function of temperature and channel radius (3.4 - 21.5 nm) is presented. In contrast to the bulk state, the birefringence resulting from the confined discotic liquid crystal, exhibits a continuous temperature evolution and is positive indicating a dominating face-on (homeotropic) type molecular ordering with respect to the channel walls. Pronounced hysteresis effects observed in the experiment are traced to different nucleation sites of the low-temperature phase upon cooling and the high-temperature phase upon heating. Deviations from the Gibbs-Thomson scaling of the phase transition temperature for channel diameters below 10 nm are traced to splay distortions of the confined liquid crystal.

Keywords: Porous silica, Porous silicon, Porous alumina, Nanocomposites, Columnar discotics

1. Introduction

The thermodynamics and microscopic structure of molecular assemblies confined in mesoporous media can be substantially altered with regard to the unconfined, bulk state [1, 2, 3]. This can originate in pure spatial restrictions or by the interactions with the confining pore walls.

Liquid crystalline systems have turned out to be particularly susceptible with regard to their phase behavior and their translational and orientational order to confinement on the nanometer scale. Both the isotropic-to-nematic and the nematic-to-smectic order behavior is often substantially altered in restricted geometries [4, 5]. Whereas in the past mainly rod-like liquid crystalline systems were in the scientific focus, the last decade has seen a growing interest in the confined state of *discotic* liquid crystals (DLCs) [6, 7, 8, 9], mainly stimulated by their possible technological applications [10].

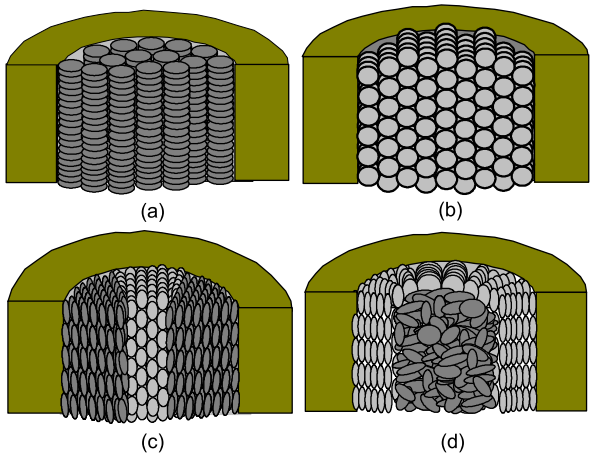

Figure 1: (color online). Molecular ordering types of DLCs in cylindrical nanochannels. (a) Parallel axial configuration. (b) Homogeneous (face-on) columnar configuration. (c) Radial multi-domain face-on configuration (d) Radial configuration with isotropic core.

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